California Energy Commission

DRAFT STAFF ANALYSIS

Staff Analysis of 2016 Nonresidential Lighting Alterations Alternatives for Demonstrating Compliance with the Existing 2013 Standards

California Energy Commission

Edmund G. Brown Jr., Governor

January 2016 | CEC-400-2016-001-SD

California Energy Commission

Gabriel D. Taylor, P.E.
Maziar Shirakh, P.E
Primary Authors

Peter Strait
Project Manager

Eurlyne Geiszler
Office Manager
BUILDING STANDARDS DEVELOPMENT OFFICE

Dave Ashuckian, P.E.
Deputy Director
EFFICIENCY DIVISION

Robert P. Oglesby
Executive Director

ABSTRACT

On November 12, 2015, the California Energy Commission adopted the 2016 revision to California Code of Regulations, Title 24, Part 6, Building Energy Efficiency Standards, Section 141.0, relating to nonresidential lighting alterations. Commission staff has determined that the newly adopted language provides a compliance pathway that saves as much or more energy than the 2013 language currently in effect. For this reason, Commission staff recommends that the language go into effect as an optional compliance pathway prior to the January 1, 2017, effective date of the rest of the Building Energy Efficiency Standards.

Keywords: Title 24, Lighting Alterations, Additional Compliance Path

Taylor, Gabriel, Maziar Shirakh. 2016. *Justification for 2016 Nonresidential Lighting Alterations Alternatives Demonstrating Compliance with the Existing 2013 Standards (DRAFT).* California Energy Commission. Publication Number: CEC-400-2016-001-SD

TABLE OF CONTENTS

Page

Abstract i

Table of Contents ii

List of Tables ii

Background 1

Purpose 2

2016 Lighting Alterations Updates 2

New Option Compared to Existing Options 3

Energy Equivalency 5

Conclusion 7

Implementation 8

APPENDIX A: 2016 Title 24, Part 6, Excerpts 9

Section 141.0(b)2I 9

Section 141.0(b)2J 9

Appendix B: Lighting Alterations Savings Analysis Tool 10

LIST OF TABLES

Page

Table 1 – Control Requirements for Luminaire Alterations 4

Table 2 – Energy Impact Analysis: New Option 3 Compared to Existing Option 1 6

Table 3 – Weighted Average Lighting Power Densities (LPDs), by Vintage 7

Background

Public Resources Code Sections 25402 and 25402.1 were enacted in 1975 as part of the enabling legislation establishing the California Energy Commission and its basic mandates. These sections require the Energy Commission to adopt, implement, and periodically update energy efficiency standards for both residential and nonresidential buildings.

On June 10, 2015, the Commission adopted the 2016 Building Energy Efficiency Standards, Title 24, Part 6, however the Commission delayed adopting changes to Section 141.0, for alterations to existing lighting systems in nonresidential buildings, to provide adequate opportunity to address public concerns. These changes were made in response to four main concerns with the previous 2013 language raised by stakeholders:

- The language was too complex which made it difficult to determine compliance
- Running new wiring for multilevel and bi-level controls made some otherwise cost effective projects no longer possible
- It was expensive to accurately determine lighting power densities, and difficult to do so for non-rectangular spaces

The Commission received more than 300 written comments on the Section 141.0 changes. After reviewing and responding to these comments, extensive work with all stakeholders, and a series of refinements to the standards language, the Commission developed Section 141.0 language that accomplishes the following:

- Retains area, automatic shutoff, and occupancy sensor controls for lighting alterations projects.
- Adds an additional compliance path for projects that reduce existing lighting power by 50 percent in hotel, office, and retail occupancies, and 35 percent in all other occupancies to not be required to have multi-level controls.
- For wiring alterations, establishes an exception for daylighting controls for wiring alterations of 10 luminaires or less in an area.

On November 12, 2015, the Commission adopted the 2016 revision to Section 141.0. Because the 2016 Section 141.0 language provides a compliance pathway that saves as much or more energy than the 2013 language at a lower cost, commenters requested that the Energy Commission consider allowing compliance with the 2016 Standards as an additional compliance path for the 2013 Standards. Commission staff has analyzed this request and is recommending that the optional percent reduction compliance path added to the 2016 Standards be approved for 2013, consistent with Public Resources Code Section 25402.1(b); Title 24, Part 1, Section 10-109; and requests received from commenters.

Purpose

Public Resources Code section 25402.1(b) authorizes and directs the Energy Commission to approve additional compliance paths for new products, materials, and calculations to demonstrate compliance with the Building Energy Efficiency Standards (Standards). Title 24, Part 1, Section 10-109 authorizes the Commission to approve alternative compliance pathways. Section 10-109(d) requires that an alternative compliance path achieve the energy savings expected by the Standards, and Section 10-109(h) authorize alternative procedures or protocols to demonstrate compliance with the existing requirements of Part 6. Once approved by the Commission, an additional compliance path may immediately be used to meet existing requirements, providing the public with an additional way to comply with the Standards.

For an additional compliance path to be approved, it must meet the following criteria:

1. Provide an additional compliance path to the existing requirements, without deleting or amending any part of the existing requirements;
2. Not result in increased energy consumption, compared to the existing requirements, for affected buildings; and
3. Follow the public review and Commission approval requirements of Section 10-110, including a 60-day comment period, before Commission approval.

2016 Lighting Alterations Updates

On November 12, 2015, the Energy Commission adopted updates to Title 24, Part 6 sections relating to nonresidential lighting alterations (Sections 141.0(b)2I, J, K, and L). These updates included the addition of an alternate compliance pathway to Sections 141.0(b)2I and J that allows projects to comply based on achieving a specified percent reduction in installed lighting power and meeting modified requirements for lighting controls. This alternate compliance path was found to save as much or more energy as the 2013 requirements for nonresidential lighting alteration projects, and to be less burdensome.

Energy Commission staff propose that the Commission approve an additional compliance path to allow the alternative compliance approach in the 2016 Standards for Nonresidential Lighting Alterations to be used for showing compliance with the existing 2013 Standards. This document demonstrates that the newly adopted lighting alterations language of the 2016 Standards Sections 141.0(b)2Iii and 141.0(b)2Jii are collectively equivalent to or more stringent than the requirements of the 2013 Standards Section 141.0(b)2I, and therefore should be allowed to be used to comply with the 2013 Standards. The full text of both Sections 141.0(b)2I and J are contained in Appendix A, but in summary the relevant sections of each accomplish the following:

Section 141.0(b)2Iii applies to lighting projects where luminaires are entirely replaced, where new luminaires are added to a space, or where walls or ceilings are added or modified. These lighting projects are given the option of meeting a modified set of control requirements as long as they also meet a high standard of overall lighting power reduction compared to the original luminaires. That reduction is at least 50 percent lower rated power at full light output for hotel, office, and retail occupancies, and at least 35 percent lower in all other occupancies.

Section 141.0(b)2Jii applies to lighting projects where only internal components of luminaires are modified, as opposed to the entire luminaire being replaced. These projects are given the same option of meeting modified control requirements as long as they also meet the same high standards of overall lighting power reductions as required for projects under Section 141(b)2I.

New Option Compared to Existing Options

The 2013 Standards allow tradeoffs between power, measured as lighting power density, and time, through the use of automated controls, while maintaining or reducing energy (kWh). Two options were provided in 2013:

- Option 1: Higher lighting power allowance and additional controls
- Option 2: Lower lighting power allowance and fewer controls

The 2016 Standards added a third option for compliance: reduction of luminaire lighting power by at least 50 percent in hotel, office, and retail occupancies or 35 percent in all other occupancies.

Table 1 compares the new 2016 Standards alternative compliance path for luminaire alterations to the two existing 2013 Standards paths. The two existing compliance paths are represented as Option 1 and Option 2, and the new compliance path is represented as Option 3. Option 3 provides an additional path for complying with the Standards when existing lighting power is reduced by 50 percent for hotel, office, and retail occupancies, or 35 percent for all other occupancies, while Option 1 and Option 2 remain as compliance paths for projects that choose to use them.

Table 1 references Section 130.1 controls requirements, and compares which controls requirements apply for each of the three options. “Yes” indicates that the specified Section 130.1 controls requirement applies. “Not required” indicates that the specified controls requirement does not apply.

Table 1 – Control Requirements for Luminaire Alterations

Applicable Section 130.1 control requirements:	Resulting lighting power, compared to the lighting power allowance in Section 140.6(c)2, Area Category Method		
	EXISTING OPTION 1 Lighting power density is > 85% of allowance	**EXISTING OPTION 2 Lighting power density is ≤ 85% of allowance**	**NEW OPTION 3 Existing lighting power is reduced by 50/35%**
Section 130.1(a)1, 2, and 3 Area Controls	Yes	Yes	Yes
Section 130.1(b) Multi-Level Lighting Controls – only for alterations to general lighting of enclosed spaces 100 square feet or larger with a connected lighting load that exceeds 0.5 watts per square foot	Yes	Bi-Level Switching - For each enclosed space, minimum one step between 30-70 percent of lighting power regardless of luminaire type, or meet Section 130.1(b)	Not Required
Section 130.1(c) Shut-Off Controls	Yes	Yes	Yes
Section 130.1(d) Automatic Daylight Controls	Yes	Not Required	Not Required
Section 130.1(e) Demand Responsive Controls – only for alterations >10,000 sq. ft. in a single building, where the alteration also changes the area of the space, or changes the occupancy type of the space, or increases the lighting power	Yes	Not Required	Not Required

Source: California Energy Commission staff

Note on Option 3: Reduction is at least 50 percent lower compared to existing rated power at full light output for hotel, office, and retail occupancies, and at least 35 percent lower rated power at full light output for all other occupancies.

Energy Equivalency

To assess the energy impact of the new Option 3 relative to existing Options 1 and 2, staff used the energy impact tool developed by the Codes and Standards Team, funded by the Investor Owned Utilities, which was used extensively during the rulemaking and posted online. The tool uses Commercial Building Energy Consumption Survey (CBECS) data on building floor space, primary activity, vintage, and other factors to calculate energy savings from each of the Standards measures. These calculated factors are combined with an estimated market share for each type of retrofit to calculate the total estimated annual energy savings achieved by each Standards compliance path for all types of lighting alterations. This tool allows for a sensitivity analysis of each of the input estimations, and for easy stakeholder review of the calculations.

Using the tool, staff analyzed the energy impact of the following scenarios:

1. Entire luminaire modifications complying with Option 1
2. Entire luminaire modifications complying with Option 2
3. Entire luminaire modifications meeting 50 percent power reduction for hotel, office, and retail occupancy (Option 3)
4. Entire luminaire modifications meeting 35 percent power reduction for all other occupancies (Option 3)
5. Luminaire component modifications meeting lighting power density requirements (Options 1 and 2)
6. Luminaire component modifications meeting 50 percent power reduction for hotel, office, and retail occupancies (Option 3)
7. Luminaire component modifications meeting 35 percent power reduction all other occupancies (Option 3)
8. Lighting wiring alterations
9. Exemptions

Staff then input estimated market share for each scenario to determine the estimated total energy savings at the most probable distribution of market share between the four types of lighting retrofit projects. The analysis determined that the new Option 3 will result in an overall increased statewide energy savings of 132 GWh in the first year of implementation. The results are summarized in Table 2 below, which shows the energy impact of Option 3 on installed lighting power and control strategies, including area, multilevel, shutoff, and daylighting controls compared to Option 1. The additional energy savings from Option 3 is due to the requirement that replacement luminaires be at least 50 percent lower rated power at full light output than the existing luminaires being replaced for hotel, office, and retail occupancies, and at least 35 percent lower rated power at full light output in all other occupancies.

Table 2 – Energy Impact Analysis:
New Option 3 Compared to Existing Option 1

Lighting Alteration Sub-Category	Section 140.6 LPD	Section 130.1(a) Area Controls	Section 130.1(b) Multi-level Controls	Section 130.1(c) Shut-off Controls	Section 130.1(d) Daylighting Controls	Total
1a. Entire Luminaire Alterations. Section 141.0(b)2I i. > 85% LPD	0.98	0	0	0.93	0	2.20
1b. Entire Luminaire Alterations. Section 141.0(b)2I i. < 85% LPD	3	0	0	3	0	5.72
1c. Entire Luminaire Alterations. (Hotel, Office & Retail) Section 141.0(b)2I ii., 50% power reduction	74	0	0	5	-12	67
1c. Entire Luminaire Alterations. (Other nonres building types) Section 141.0(b)2I ii., 35% power reduction	52	0	0	6	-15	43
2a. Luminaire Comp. Modifications. Section 141.0(b)2J i: >40 Luminaire / floor, meet LPD	6	0	0	5	-9	3
2b. Luminaire Comp. Modifications. (Hotel, Office & Retail) Section 141.0(b)2J ii: >40 Luminaire / floor, 50% power reduction	17	0	0	-2	-4	10
2b. Luminaire Comp. Modifications. (Other nonres building types) Section 141.0(b)2J ii: >40 Luminaire / floor, 35% power reduction	14	0	0	-4	-9	1
2c. Luminaire Comp. Modifications. Section 141.0(b)2J ii: <40 Luminaire / floor	0	0	0	0	0	0
3. Lighting Wiring Alterations.	0	0	0	0	-1	-1
4. Exempted entire luminaire alterations, luminaire component modifications, and lighting wiring alterations	0	0	0	0	0	0
Sub-Total	168	0	0	13	-49	132
Total Energy Impact Reduction	**132 GWh/year**					

Source: California Energy Commission staff

The result is deeper energy savings for all area category occupancies and for all vintages of lighting systems as shown in Table 3. Table 3 shows greater savings for Option 3, compared to Option 1 and Option 2, even for existing lighting systems that comply with the 1998 Standards. More recent lighting systems will result in even greater energy savings when complying with the new Option 3.

Table 3 – Weighted Average Lighting Power Densities (LPDs), by Vintage

	Area Category Method Lighting Power Density (Watts/sf)				
	Standards Vintage:				
Function Areas:	**1998 / 2001**	**2005**	**2008**	**2013**	**2016**
Auditorium	0.030	0.023	0.023	0.023	0.021
Classroom, Lecture	0.141	0.106	0.106	0.106	0.106
Commercial Storage	0.083	0.083	0.083	0.083	0.083
Corridors, Restrooms, Support	0.012	0.012	0.012	0.012	0.012
Convention, Conference	0.023	0.021	0.021	0.021	0.018
Dining	0.080	0.080	0.080	0.080	0.073
Exercise, Gym	0.015	0.015	0.015	0.015	0.015
Exhibit, Museum	0.030	0.030	0.030	0.030	0.027
General Commercial High Bay	0.018	0.017	0.015	0.015	0.015
General Commercial Low Bay	0.015	0.015	0.014	0.014	0.014
General Commercial, Precision	0.023	0.020	0.018	0.018	0.018
Grocery	0.024	0.024	0.024	0.018	0.018
Hotel	0.122	0.083	0.083	0.083	0.077
Library Reading Areas	0.018	0.018	0.018	0.018	0.017
Library Stacks	0.023	0.023	0.023	0.023	0.023
Lounge	0.017	0.017	0.017	0.017	0.014
Malls	0.018	0.018	0.018	0.018	0.014
Medical and Clinic	0.053	0.045	0.045	0.045	0.045
Office	0.287	0.265	0.210	0.179	0.179
Religious Worship	0.032	0.023	0.023	0.023	0.023
Retail	0.314	0.267	0.251	0.188	0.188
Theater Area	0.014	0.014	0.014	0.014	0.014
OPTION 1 - Weighted Average LPD	1.39	1.21	1.14	1.04	1.01
OPTION 2 - 85% of 2016 LPDs	0.86	0.86	0.86	0.86	0.86
OPTION 3 - 50/35% Power Reduction	0.79	0.70	0.66	0.61	0.58
Savings for Option 3 over Option 2	**8%**	**19%**	**23%**	**29%**	**33%**

Source: California Energy Commission staff

Note on Table 3: The LPDs for each function area are weighted based on the estimated annual square feet of lighting alterations for each function area. The resulting weighted average LPDs for all vintages under the new Option 3 are lower than the Option 1 and 2 LPDs, resulting in the savings shown on the bottom row of the table.

Conclusion

Allowing this additional compliance path will result in an additional 132 GWh of electricity savings per year, while improving the cost effectiveness of small and medium sized lighting retrofit projects that may not have been viable under the current code requirements. Since the option added in the 2016 Standards will save energy compared to the current code, staff recommends that it be approved by the Commission at the earliest possible date as an additional compliance path for the 2013 Standards, pursuant to the requirements of Title 24, Part 1, Section 10-109, after a 60-day comment period, pursuant to the requirements of Section 10-110.

Implementation

Since this additional compliance path will go into effect as soon as it is approved by the Commission, the Standards Implementation Office will work quickly to inform the building community and code enforcement representatives in the following ways:

- Post all additional compliance path documents on the Commission's website
- Send out a notification to the Building Standards list-serve
- Publish a *Blueprint* article detailing the change
- Train the Energy Standards Hotline staff on the new Option 3 and ensure they are able to answer questions
- Update training materials and presentations and provide them to enforcement agencies
- Work with Energy Code Ace to update and review their tools and resources to ensure consistency with the changes

APPENDIX A: 2016 TITLE 24, PART 6, EXCERPTS

Section 141.0(b)2I

I. **Entire Luminaire Alterations.** Entire luminaire alterations shall meet the following requirements:

i. For each enclosed space, alterations that consist of either (a) removing and reinstalling a total of 10 percent or more of the existing luminaires; or (b) replacing or adding entire luminaires; or (c) adding, removing, or replacing walls or ceilings along with any redesign of the lighting system, shall meet the lighting power allowance in Section 140.6, and the altered luminaires shall meet the applicable requirements in Table 141.0-E; or

ii. For alterations where existing luminaires are replaced with new luminaires, and that do not include adding, removing, or replacing walls or ceilings along with redesign of the lighting system, the replacement luminaires in each office, retail, and hotel occupancy shall have at least 50 percent, and in all other occupancies at least 35 percent, lower rated power at full light output compared to the existing luminaires being replaced, and shall meet the requirements of Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)2, 130.1(c)3, 130.1(c)4, 130.1(c)5, 130.1(c)6A, and for parking garages 130.1(c)7B.

EXCEPTION 1 to Section 141.0(b)2I. Alteration of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded as specified in Section 140.6(a)3.

EXCEPTION 2 to Section 141.0(b)2I. In an enclosed space where two or fewer luminaires are replaced or reinstalled.

EXCEPTION 3 to Section 141.0(b)2I. Alterations that would directly cause the disturbance of asbestos, unless the alterations are made in conjunction with asbestos abatement.

EXCEPTION 4 to Section 141.0(b)2I. Acceptance testing requirements of Section 130.4 are not required for alterations where lighting controls are added to control 20 or fewer luminaires.

Section 141.0(b)2J

J. **Luminaire Component Modifications**. Luminaire component modifications in place that include replacing the ballasts or drivers and the associated lamps in the luminaire, permanently changing the light source of the luminaire, or changing the optical system of the luminaire, where 70 or more existing luminaires are modified either on any single floor of a building or, where multiple tenants inhabit the same floor, in any single tenant space, in any single year, shall not prevent or disable the operation of any multi-level, shut-off, or daylighting controls, and shall:

i. Meet the lighting power allowance in Section 140.6 and comply with Table 141.0-E; or

ii. In office, retail, and hotel occupancies have at least 50 percent, and in all other occupancies have at least 35 percent, lower rated power at full light output as compared to the original luminaires prior to being modified, and meet the requirements of Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)2, 130.1(c)3, 130.1(c)4, 130.1(c)5, 130.1(c)6A, and for parking garages 130.1(c)7B.

Lamp replacements alone and ballast replacements alone shall not be considered a modification of the luminaire provided that the replacement lamps or ballasts are installed and powered without modifying the luminaire.

EXCEPTION 1 to Section 141.0(b)2J. Modification of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded by Section 140.6(a)3.

EXCEPTION 2 to Section 141.0(b)2J. In an enclosed space where two or fewer luminaires are modified.

EXCEPTION 3 to Section 141.0(b)2J. Modifications that would directly cause the disturbance of asbestos, unless the modifications are made in conjunction with asbestos abatement.

EXCEPTION 4 to Section 141.0(b)2J. Acceptance testing requirements of Section 130.4 are not required for modifications where lighting controls are added to control 20 or fewer luminaires.

APPENDIX B: LIGHTING ALTERATIONS SAVINGS ANALYSIS TOOL

Four page Lighting Alterations Savings Analysis Tool appended beginning on next page.

2016 T-24 Lighting Alteration Categories, Market shares, and regulation coverage

Main-categories of Lighting Alterations	Estimated Market Shares of main-categories	Sub-Categories of Lighting Alteration	Sub-category market share in corresponding Main-category	Estimated Market Shares of Sub-categories	Regulated by 2016 T24?	Regulation by requirement type: 140.6 LPD	130.1(a) Area Control	130.1(b) Multi-level	130.1(c) Shut-off	130.1(d) Daylighting	130.1(e) DR Control
Section 141.0(b)2I Entire Luminaire Alterations	64%	1a. Entire Luminaire Alterations. Section 141.0(b)2I i. > 85% LPD	8%	5%	Yes	Yes	Yes	Yes	Yes	Yes	
		1b. Entire Luminaire Alterations. Section 141.0(b)2I i. < 85% LPD	33%	21%	Yes	Yes	Yes	bi-level	Yes		
		1c. Entire Luminaire Alterations. (Hotel, Office & Retail) Section 141.0(b)2I ii., 50% power reduction	26%	16%	Yes	Equivalent			Yes		
		1c. Entire Luminaire Alterations. (Other nonres building types) Section 141.0(b)2I ii., 35% power reduction	33%	21%	Yes	Equivalent			Yes		
Section 141.0(b)2J Luminaire Component Modifications	30%	2a. Luminaire Comp. Modifications. Section 141.0(b)2J i: >40 Luminaire / floor, meet LPD	42%	13%	Yes	Yes	Yes		Yes		
		2b. Luminaire Comp. Modifications. (Hotel, Office & Retail) Section 141.0(b)2J ii: >40 Luminaire / floor, 50% power reduction	15%	5%	Yes	Equivalent	Yes		Yes		
		2b. Luminaire Comp. Modifications. (Other nonres building types) Section 141.0(b)2J ii: >40 Luminaire / floor, 35% power reduction	29%	9%	Yes	Equivalent	Yes		Yes		
		2c. Luminaire Comp. Modifications. Section 141.0(b)2J ii: <40 Luminaire / floor	13%	4%	No						
Section 141.0(b)2K Lighting Wiring Alterations	5%	3. Lighting Wiring Alterations.	100%	5.0%	Yes	Yes	Yes	bi-level	partial	partial	
Exempted Alterations	1%	4. Exempted entire luminaire alterations, luminaire component modifications, and lighting wiring alterations	100%	1%	No						
Total Market Share	100%		Total Market Share	100%							

2016 T-24

Market Shares of regulated alterations

140.6 LPD	130.1(a) Area Control	130.1(b) Multi-level	130.1(c) Shut-off	130.1(d) Daylighting	130.1(e) DR Control
5%	5%	5%	5%	5%	
21%	21%		21%		
16.4%			16%		
21.2%			21%		
12.7%	13%		13%		
4.5%	9%		5%		
8.8%	9%		9%		
5.0%	5.0%	5.0%	5.0%	4.25%	
95%	**62%**	**10%**	**95%**	**10%**	

Level of stringency compared to 2013 T-24

140.6 LPD	130.1(a) Area Control	130.1(b) Multi-level	130.1(c) Shut-off	130.1(d) Daylighting	130.1(e) DR Control
100%	100%	100%	100%	100%	
100%	100%		100%		
250%			98%		
175%			98%		
100%	100%		98%		
250%	100%		98%		
175%	100%		98%		
100%	100%	100%	98%	100%	

Savings

140.6 LPD	130.1(a) Area Control	130.1(b) Multi-level	130.1(c) Shut-off	130.1(d) Daylighting	130.1(e) DR Control
15	0	0	11	4	
59	0	0	43		
114	0	0	33	0	
104	0	0	42	0	
35	0	0	25	0	
32	0	0	9	0	
43	0	0	18	0	
14	0	0	10	4	
417	**0**	**0**	**191**	**8**	

2013 T-24

Market Shares of regulated alterations

140.6 LPD	130.1(a) Area Control	130.1(b) Multi-level	130.1(c) Shut-off	130.1(d) Daylighting	130.1(e) DR Control
5%	5%	5%	5%	5%	
20%	20%	20%	20%		
14%	14%	14%	14%	14%	
19%	19%	19%	19%	19%	
10%	10%	10%	10%	10%	
5%	5%	5%	5%	5%	
10%	10%	10%	10%	10%	
0%	0%	0%	0%	0%	
5%	5%	5%	5%	5%	
0.0%	0.0%	0.0%	0.0%	0.0%	
89%	**89%**	**89%**	**89%**	**69%**	

Savings (GWh)

140.6 LPD	130.1(a) Area Control	130.1(b) Multi-level	130.1(c) Shut-off	130.1(d) Daylighting	130.1(e) DR Control
14	0	0	10	4	
56	0	0	41	0	
40	0	0	29	12	
52	0	0	38	15	
29	0	0	21	9	
15	0	0	11	4	
29	0	0	21	9	
0	0	0	0	0	
14	0	0	10	4	
0	0	0	0	0	
249	**0**	**0**	**181**	**57**	

2016 T-24 Market Shares of alterations subject to warehouse control requirements	2016 T-24 Warehouse shut-off control savings	2013 T-24 Warehouse shut-off control savings
5%	3	3
21%	13	12
16%	10	9
21%	13	11
13%	8	6
5%	3	3
9%	5	6
	0	0
5.0%	3	3
	0	0
95%	**59**	**55**

Impact of 2016 T-24 Lighting Alteration Requirements

Lighting Alteration Sub-Category	Section 140.6 LPD	Section 130.1(a) Area Controls	Section 130.1(b) Multi-level Controls	Section 130.1(c) Shut-off Controls	Section 130.1(d) Daylighting Controls	Total
1a. Entire Luminaire Alterations. Section 141.0(b)2I i. > 85% LPD	0.98	0	0	0.93	0	2.20
1b. Entire Luminaire Alterations. Section 141.0(b)2I i. < 85% LPD	3	0	0	3	0	5.72
1c. Entire Luminaire Alterations. (Hotel, Office & Retail) Section 141.0(b)2I ii., 50% power reduction	74	0	0	5	-12	67
1c. Entire Luminaire Alterations. (Other nonres building types) Section 141.0(b)2I ii., 35% power reduction	52	0	0	6	-15	43
2a. Luminaire Comp. Modifications. Section 141.0(b)2J i: >40 Luminaire / floor, meet LPD	6	0	0	5	-9	3
2b. Luminaire Comp. Modifications. (Hotel, Office & Retail) Section 141.0(b)2J ii: >40 Luminaire / floor, 50% power reduction	17	0	0	-2	-4	10
2b. Luminaire Comp. Modifications. (Other nonres building types) Section 141.0(b)2J ii: >40 Luminaire / floor, 35% power reduction	14	0	0	-4	-9	1
2c. Luminaire Comp. Modifications. Section 141.0(b)2J ii: <40 Luminaire / floor	0	0	0	0	0	0
3. Lighting Wiring Alterations.	0	0	0	0	-1	-1
4. Exempted entire luminaire alterations, luminaire component modifications, and lighting wiring alterations	0	0	0	0	0	0
Sub-Total	168	0	0	13	-49	132
Total Energy Impact Reduction	**132 GWh/year**					